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EDITORIAL NOTES

COMPETITION AND GLAMOUR

AS was unmistakably evidenced at the recent meeting of the American Gas Association to which we referred in these columns last week, a great deal of hard thinking and heart searching is taking place in the American Gas Industry on the question of how it will stand *vis-à-vis* electricity in the immediate post-war period. Unmistakable, too, is the vast majority opinion that the competition between gas and electricity will dwarf in intensity anything experienced in pre-war days—and the fight was grim enough then. Not that we gain the impression that the Gas Industry in the States is suffering from knocking of the knees. On the contrary we are struck with its vigorous attitude, and its determination to face what it considers after much seeking and analysis to be the facts of the case. We ourselves hope that after the war there will in our own country be some common and workable understanding between gas and lectricity—indeed, between all the fuels—in the interests of coal onservation, the consumer, and incidentally the fuel industries hemselves. Such a hope, which we trust is not merely pious, does not imply that mutual understanding, or at any rate some measure of it, should render it unnecessary for each industry to exert its best efforts in the way of development. The demands of the public—of the housewife and the industrialist alike—will, we think, make such development essential, and if any one of the fuel interests slackens up in its service it will not be slow to suffer.

It is trite to say that conditions in this country differ in many ways from those in America, and that comparisons are not valid. To our mind, however, there are many points of action and policy which have some similarity, and we find what the American Gas Industry is thinking—and doing—to-day of great interest and considerable importance, and we like what we may term the Industry's vividness. Definitely it cannot be charged with being complacent, and, as we have said, it is doing a good deal of heart searching. At the beginning of 1943 in the United States the electricity industry had 50% more domestic consumers than gas had; the difference was nearly ten million meters—ten million more customer contacts. War needs have accelerated the installation of electric generating capacity throughout the country. All this wartime capacity will be a factor of first importance when the war is over. With surplus plant capacities it is likely that electricity undertakings will seek the domestic cooker load with or without the water-heating load. Since 1934 the average use of electricity per domestic consumer has advanced more than 60%. Compared with this, it was stated at the A.G.A. meeting that domestic manufactured gas service, including a considerable increase in space heating, is barely holding its own. Natural gas advanced 14% in domestic use in the same period. The situation, in a nutshell, is regarded as warranting much thought, because it is serious. One analysis, covering thousands of consumers, showed that the consumer cost differential in favour of gas over electricity for cooking was about 5s. a month—considered to be an insignificant margin—and according to a committee reporting on the matter, "no longer can the Gas Industry rely on rate advantage to hold its cooking load." It must be ready to replace obsolete cooking equipment with cookers of greater appeal than those which will be offered by the electricity industry. It is thought that electric water heating, even at off-peak rates, is no immediate threat where gas is available. At the same time, "the one great truth about the domestic gas water heating business is that the Gas Industry has failed to make people understand that modern gas water heaters afford quick action and absolutely continuous economical service."

Which brings us to the matter of advertising. It does not take a crystal gazer to predict a very great demand for new appliances after the war. Last June one of the American gas undertakings found they could offer sixty refrigerators. They announced the fact on a "first-come, first served" basis. Several hundred men and women responded by queuing up all night waiting for the opening of the showroom doors. Of course the demand will be immense. How, it was asked at the A.G.A. meeting, will gas stand in relation to electricity? During the past few years, whenever an American housewife has opened a national magazine she has been confronted with approximately eight times as much advertising extolling the wonders of electricity and the virtues of electric appliances as has advocated the use of gas. This has been going on throughout the war. Of course the American Gas Industry has advertised, but its effort—at any rate on the basis of funds allocated for the purpose—has been small in comparison with electricity. It was in 1936 that the Industry started a national effort to combat electrical competition. The campaign was based on the relatively small contribution of 4 cents per meter from all contributing undertakings. Not every undertaking contributed, but every undertaking naturally benefited. That is an old, old story. When the campaign was started, surveys showed that the public attitude towards gas was veering to the belief that gas was old-fashioned—even for cooking. The problem was, quite briefly, to rebuild the prestige of the Gas Industry in the eyes of the public and to give renewed encouragement to gas personnel. The results were wholly constructive in developing a new respect for the Industry in the ranks of other industries, and in acting as a stimulus to the morale of those within the Industry and as an impetus to more aggressive action. The advertising has been continuous irrespective of war conditions. What about the future?

It is the feeling of the American Gas Association that the post-war demand for appliances will not in itself protect the gas load in competition with electricity—that if a swing to competitive fuels is intensified when restrictions on appliance and equipment manufacture are lifted, the gas load can be seriously and permanently affected. So it has asked itself what type of advertising programme the Industry needs at the present time. It has answered the question in part by saying that the advertising must be adequate in scope to make a genuine impression on a nation-wide basis, and that *it must combat the glamour which has become associated with electricity in the minds of too many domestic consumers*. The A.G.A. came to the conclusion that if an attempt was made to depict the future home on a factual level the advertising would not be greatly dissimilar to much of that in the past, and that it would fail to give impetus to the ability of gas to bring about new standards of living. A fresh approach was sought, unhampered, be it noted, by past conventional thinking. We have been favoured by the A.G.A. with "pulls" of their current and future advertisements, and there is nothing stodgy about them. To us they do seem to depict the results of gas service rather than the physical means by which this service is rendered. They give to gas a quality of magic; they are alive, attention-arresting—the sort of advertisement to make even the tired housewife of to-day sit up and take notice. There is nothing lethargic about them. They are in a sense "daring," but we think this conception is absolutely sound. It is, we think, advertising which will be noticed—and not only noticed but remembered. The slogan for the campaign sums up this conception. It is: "The Flame that Will Brighten Your Future." A much-needed cheerful note of glad tidings amid gloom. An antidote to excessive electricity "glamour."

Conditions, as we have remarked, are different in this country from those in America, but maybe we have something to learn by studying American methods of advertising and the motives activating them. Are we in this country setting out to make gas

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a vivid subject and its future service a pleasurable anticipation? Do we lend a little glamour to our advertisements? Or are we inclined on occasion to be dull and a trifle pontifical? We say "on occasion" advisedly. Some of our advertising in the past—quite a good deal of it—has been both vivid and apt. But are we looking to the future radiating cheerfulness in our belief in the flame which will brighten it? For electricity would appear to have glamour, even if some of that glamour is only moonshine. At all events it seems to enjoy on all manner of occasions an uncommonly good "press." As instance the publicity following a deputation of the Electrical Vehicle Association to the Minister of War Transport a few days ago, which deputation explained the "outstanding merits" of a new "national standard electric vehicle"—a vehicle which runs on home-produced fuel. What is happening to the town gas and the producer gas vehicle? Or does no glamour attach to them? This is a minor instance, admittedly, but it is a straw pointing the direction of the wind.

THE PROPOSED B.G.A.

THE Planning Report of the British Gas Federation suggested both short and long term reorganization as being needed to fit the Gas Industry for all-out service in the post-war world. As we remarked at the time of issue of the Report, whatever divergence of view there might be in other respects, the frank acknowledgment of the Federation would be universally endorsed that reconstruction at the centre was an essential first step. In some detail the Report drew the pattern for what appears to us to be the key even to first beginnings, and on several occasions since then we have expressed alarm at the apparent lack of progress in forming the proposed British Gas Association. In the absence of official news, we can only assume that legal brains are wrestling with proposed constitutions and other problems so difficult of solution in an Industry constituted as ours is at present, and that questions of ownership, proportional representation, and so forth are overclouding the whole situation. In the meantime the Industry is handicapped at this very critical stage of affairs by lack of direction at the centre and of co-ordination of effort. Whereas, for example, the old organizations still exist for gas engineering, for coke, for legal and parliamentary matters, for public relations and publicity, even if certain vital ones such as utilization remain unprovided for, they must needs continue to function in comparatively watertight compartments until such time as their efforts are co-ordinated by some such central authority as the projected B.G.A. What concerns us most is that the Industry shall with the least possible delay reach a condition in which it can cease to regard its own internal worries as all-absorbing and, either by eliminating them or by relegating them to their proper sphere, re-orient its outlook towards the future. It would be wiser, even, to say the present, because even to-day the cry goes up for more and more promises for to-morrow, and the industry which has no time to state what it can definitely offer may well find itself in a very cold corner of a not too distant future.

Personal

As we have already announced, Mr. H. E. BLOOR, Director and General Manager of the York Gas Company, is shortly to retire, but will continue as Consultant to the Company. His successor is Mr. Charles Bateman. On Dec. 31 a representative gathering of employees presented Mr. Bloor with a salmon rod and heard the following resolution: "Upon the impending retirement of Mr. H. E. Bloor, the Directors desire to place on record their high appreciation of his services to the Company during the past 30 years, during which period he has carried out the duties of his various responsible offices with great distinction and to the immense advantage of the Company and to the entire satisfaction of his colleagues: and hope for continued happy association in his new capacity."

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Mr. W. L. WESTBROOK, Distribution Superintendent of the North Middlesex Gas Company for the past 32 years, retired from the service of the Company on Dec. 31 last at the age of 66. Mr. Westbrook first joined the Company in 1911, having previously held a similar appointment with the Hereford Corporation Gas Department. He took a lively interest in the activities of the London and Southern District Junior Gas Association, of which he is a Past-President. Upon his retirement he was the recipient of a china tea service, presented to him by the members of the staff as a token of their esteem for his friendship, and for the courtesy and loyalty he has always shown to those who came in contact with him.

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Sir FRANCIS JOSEPH, Bart., K.B.E., D.L., President of the Society of British Gas Industries, has been elected President of the Institute of Industrial Administration in succession to Lord Davidson.

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Mr. JOHN BYROM, Deputy Engineer and Manager of the Stalybridge Gas Department, is retiring after 43 years' service in the Gas Industry; 38 years have been spent with the Stalybridge Undertaking, and 5 years during the last war with the Great Grimsby Gas Company. In agreement with the Gas-Works Committee he continued his services for 12 months after reaching the age of 65. Mr. Byrom is one of the oldest members of the Manchester and District Junior Gas Association.

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Mr. C. L. DAVIES, Secretary and Commercial Assistant, Stourbridge Gas Department, has been appointed Secretary of the Yorkshire Gas Coke Association.

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Barnoldswick District Council have accepted the resignation of their temporary Gas Engineer, Mr. R. N. WEBB, appointed three years ago when the permanent Engineer was released for service with the Forces. Mr. Webb, aged 66, is not in good health.

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We are glad to announce that Mr. J. H. Canning, O.B.E., J.P., of Newport, and Mrs. Canning, have received a telegram from their fourth son, Captain J. G. CANNING, R.A., from Switzerland. Captain Canning, formerly on the editorial staff of the "JOURNAL," was, prior to this telegram, last heard of in August as a prisoner of war in Northern Italy.

Letters to the Editor

Gas Boards

DEAR SIR,—I was pleased to read the article "Gas Boards on London Transport Lines" in your issue of Dec. 15 last. The scheme of public ownership for the Gas Industry which I set out in detail, and which was published in your issue of Sept. 29, 1943, is similar in pattern to that of the London Passenger Transport Board.

The Report on the Planning of the Gas Industry dismisses nationalization as being unnecessary, but says little about public ownership, which is an entirely different system. The Report provides for piecemeal integration, which will not suffice and, further, does not exercise compulsion, which is essential. It is not enough to carry out integration in the densely populated areas, leaving large rural areas to go all electrical. The Gas Industry could and should supply the heating requirements of the rural areas, but this can only be done by an all-embracing scheme of integration. The new post-war houses will be supplied with electricity for lighting, wireless, and vacuum cleaners, and if gas is not available at competitive rates, the heating requirements will also go to electricity, and this will involve a greater consumption of raw coal than if done by gas and coke.

Even now a few small gas undertakings are fading out, leaving the field completely open to electricity, and other small ones are being kept going only with the assistance of neighbouring undertakings. The big majority of undertakings are very efficient and have stood up to wartime conditions remarkably well, but the strength of any chain is its weakest link.

It is understood that the Central Electricity Board has already planned all the plant replacements and extensions at every generating station in the country for four or five years ahead. The larger undertakings have programmed for some time ahead, but generally as separate undertakings and without co-ordination, which may result in unnecessary standby plant, &c.

The Report may be summarized in a few words, "Leave the Gas Industry alone—it can put its own house in order." If this policy is allowed to continue, the Industry will have missed a golden opportunity of going ahead of the electricity industry. At present the Central Electricity Board has statutory powers to operate electricity generating stations, but not to own them, neither do its powers include distribution and utilization. The Gas Industry can go ahead, but only by adopting a comprehensive scheme of public ownership.

The processing of coal by carbonization provides the most economic use of raw coal, and the Gas Industry has the strongest possible claim to provide the heat requirements of the community. In order to attain this service to the public with the maximum efficiency and economy, the bringing of all undertakings into a scheme of public ownership is essential.

Bradford Gas Department,
Britannia House, Bradford.
Dec. 24, 1943.

Yours faithfully,
GEO. E. CURRIER,
Engineer and Manager.

"Co-operation in Industry"

DEAR SIR,—In my remarks on trade and post-war reconstruction I have drawn attention from time to time to the value and importance of co-partnership and profit-sharing arrangements in industrial undertakings. To suggest that these are in any way a recent development would be doing a great injustice to the pioneers of the movement, and those who have been making use of it much to the employees' benefit.

It would be easy to give examples in various trades all over the country, but I will restrict myself to the Gas Industry, with which I have been in touch for over half a century, and which can claim to have had within its ranks the chief pioneer in this valuable scheme. I well remember its initiation by the late Sir George Livesey, of the South Metropolitan Gas Company, many years ago, and it has been worthily continued by his successors in that Company and in neighbouring concerns. A striking illustration is furnished by the Brighton, Hove, and Worthing Gas Company, whose Chairman, Mr. A. M. Paddon, has always taken a keen interest in the movement. I believe I am right in saying that the Company's employees now own about £114,000 of its stock.

Employees not only benefit financially, but they have a direct share in the management, as they have their own special director whose technical skill is valued highly by the Board. They thus retain their individual freedom and, if I may use the term, their industrial manhood.

Compare this with the thraldom under State and bureaucratic control and trades union interference and intimidation, and I think it will be agreed that we have here a far better method of securing that industrial co-operation so essential to our national prosperity.

Yours faithfully,
H. REGINALD SIBSON.

Hove.
Jan. 6, 1944.

Post-War Street Lighting

DEAR SIR,—As Public Lighting Engineer for the City of Leeds, I should be glad to hear from manufacturers of street lamps whether, as part of their post-war policy, they have any new suggestions to offer regarding street lighting.

Leeds Gas Department,
Market Hall, Leeds, 2.
Jan. 6, 1944.

Yours faithfully,
C. S. SHAPLEY,
Engineer and General Manager.

A Message to the A.G.A.

The following cable has been sent by Sir Francis Joseph, Bart., K.B.E., D.L., President of the Society of British Gas Industries, to the President of the American Gas Association:

"At the dawn of the New Year I beg to send you greetings and good wishes from your friends in the Society of British Gas Industries.

"As Allies, we have come safely through the long, dark night of trial and tribulation. With the New Year we know that victory will be achieved.

"Your kinsmen over here have won a sure place in our hearts. They have proved themselves grand ambassadors of international goodwill.

"Continued co-operation will solve the problems of a stricken but free world; I am sure our hearts and hands will be firmly linked together in peace as in war."

Institution of Gas Engineers

The following elections to membership of the Institution have been made:

Membership (7).—Eaton, Frederick John, B.Sc., Ph.D., Chemist, Gas Light and Coke Company; Harris, Percy Thomas, Engineer and Manager, Market Harborough Gas Department; Holmes, Frederick Brian, Joint Managing Director, W. C. Holmes & Company, Ltd.; Hyde, Claudius George, A.R.C.S., Controller of Gas Testing, Ministry of Fuel and Power; Irving, Roy Forbes, Engineering Assistant, Bournemouth Gas and Water Company; Poulter, Lionel Charles Stevens, Divisional Manager, North-Western Division, Gas Light and Coke Company; Williams, Leonard Charles Gray, Engineer and Manager, British Gas Light Company, Ltd., Thetford.

Associate Membership (28).—Arnold, Robert Charles, Technical Assistant, Loughborough Gas Department; Baines, Raymond Arthur, Technical Assistant, Burnley Gas Department; Blenkiron, Allan, Shift Engineer, Bradford Gas Department; Bottomley, Harold, Sales Manager, Caledonian Gas Corporation, Ltd.; Brand, William James, Technical Assistant and Chemist, Lea Bridge District Gas Company; Broomhead, Frank, Technical Representative, W. C. Holmes & Company, Ltd.; Brown, Wilfrid, Technical Assistant, Buckhaven and Leven Gas Commissioners; Clifton, Victor Ernest, M.Sc., Chief Chemist, Derby Gas Light and Coke Company; Davies, Godfrey Valentine Cunliffe, B.Sc., Operating and Erecting Engineer, Humphreys & Glasgow, Ltd.; Driver, Arthur George, District Technical Assistant, South Suburban Gas Company; Fairman, John Robert, Draughtsman, Southampton Gaslight and Coke Company; Ferguson, Derrig, Assistant Chemist, Liverpool Gas Company; Hateley, Richard Noel, Works Superintendent, Walsall Gas Department; Heaton, Arthur, B.Sc.(Eng.), Technical Assistant, Dewsbury Gas Department; Jones, Martin William, M.A., Gas Technical Officer, Ministry of Fuel and Power; Kehoe, Edward Francis, Assistant Works Chemist, Manchester Gas Department; Lomax, John, Works Chemist, Cambridge University and Town Gas Light Company; Miller, Robert, Technical Assistant, Bath Gas Company; Pugh, John Edwin, Gas Equipment Engineer, Gas Light and Coke Company; Rees, William David, Technical Assistant, Port Talbot Corporation Gas Department; Rich, John Brian, B.Sc., Works Superintendent, Torquay and Paignton Gas Company; Sapsford, James, B.Sc.Tech., Technical Assistant, Sutcliffe, Speakman & Company, Ltd.; Smith, John Frederick, Works Chemist, Burnley Gas Department; Smith, John Sharp, B.Sc., Chemist, Gas Light and Coke Company; Thompson, Robert Joseph Stanley, B.Sc., Chemical Engineer, W. C. Holmes & Company, Ltd.; Thornton, Donald Herbert, Assistant to Engineer, Watford and St. Albans Gas Company; Wilkinson, James Henry, Technical Assistant and Works Chemist, Sedgley Gas Department; Woodcock, Jack, Technical Assistant, Nelson Gas Department.

Associateship (2).—Diamond, William Edward le Boutillier, M.A., Ph.D., General Manager, British Plastics Federation, Ltd.; Drummond, Roy Macgregor, Managing Director, Drummond Patents (Holdings), Ltd.

Additional Examination Results, 1943

The following is a supplement to the List published on Aug. 18, 1943: Candidates qualifying for Certificates in Gas Engineering (Manufacture) or Gas Engineering (Supply).

EXTERNAL CANDIDATES.

Higher Grade Gas Engineering (Manufacture).

Class.	Name.	Town.
Second ...	... Birch, L. S.	Jamaica, B.W.I.

Ordinary Grade Gas Engineering (Manufacture).

Class.	Name.	Town.
First ...	... Friggens, J. B.	Penzance
Second ...	... King, W. E. H.	Truro
" ...	... Lush, R. W. L.	Weston-super-Mare

Ordinary Grade (Single Subject) Examination in Gas Engineering (Supply), to qualify to sit for the Diploma Examination in Gas Engineering (Manufacture).

Class.	Name.	Town.
First ...	... Seager, A. C.	Southend-on-Sea

INTERNAL CANDIDATES.

Higher Grade Gas Engineering (Manufacture).

Class.	Name.	Centre.
First ...	... Brown, W.	Edinburgh
Second ...	... Baines, R. A.	Burnley
" ...	... Walton, W.	"

Ordinary Grade Gas Engineering (Manufacture).

Class.	Name.	Centre.
Second ...	... Barker, G. F. L.	Huddersfield
" ...	... Haydock, R.	Burnley
" ...	... Sawyer, F. W.	Huddersfield

Higher Grade Gas Engineering (Supply).

Class.	Name.	Centre.
Second ...	... Badcock, A. C.	Westminster

Corrections to List published on Aug. 18, 1943:

External Candidates in Ordinary Grade Gas Engineering (Manufacture).

Class.	Name.	Town.
First (not Second)	Painter, F. J.	Doncaster
Second ...	... Hoyle, G. (not Houle, G.)	Halifax

Diary

Jan. 15.—Scottish Junior Gas Association, Edinburgh.
Jan. 17.—London and Counties Coke Association: Finance Committee, 11 a.m.; Executive Committee, 11.30 a.m.; Central Committee, 1.30 p.m.; Gas Industry House.
Jan. 18.—Illuminating Engineering Society: Meeting with the R.I.B.A. at 66, Portland Place, W. 1, 5.30 p.m. Discussion on the place of science in the art of lighting.
Jan. 20.—Industrial Gas Centres Committee: Gas Industry House, 10 a.m.
Feb. 4.—Southern Association (Eastern District): Gas Industry House, 2.30 p.m. Paper on Plastics.

The next Meeting of members of the Fuel Luncheon Club will take place at the Connaught Rooms, Great Queen Street, W.C. 2, on Jan. 21, at 12.40 for 1.10 p.m., when the after-luncheon Address will be given by Lt.-Colonel C. E. Lancaster, M.P.

Fuel Research

In an Address to the Institute of Fuel in Newcastle-upon-Tyne Dr. **A. Parker,** Director of Fuel Research of the Department of Scientific and Industrial Research, said that the outstanding scientific and technical achievements of this country, especially during the war, have proved beyond doubt that our scientists are at least equal in ability to those in any part of the world. Though the quality of our scientific work is not surpassed anywhere, we have lagged behind some other countries, for example Germany and the United States, in the amount of research. This is because the value of scientific research has not been sufficiently recognized, and in consequence the number of trained scientists in this country has been relatively small. If we are to occcupy a prominent place in world affairs after the war there must be a great expansion in our scientific research and in the application of science in industry.

History repeats itself! Exactly the same conclusions emerged from our experience during the war of 1914–1918. Between 1918 and 1939 there was a considerable expansion in scientific training and research activities, but the expansion was neither so rapid nor so extensive as desirable. It was during the last war that the Government gave a lead by establishing the Department of Scientific and Industrial Research. One of the first activities of this new Department was to set up the Fuel Research Board to investigate in the broadest national interest the nature, preparation, utilization, and treatment of coal and other fuels, and their products. The establishment of the Government Fuel Research organization was in itself an innovation, for nowhere else in the world was there at that time an organization on quite the same lines.

To-day, this State organization, with a staff of more than 250, includes the central Fuel Research Station equipped not only for experiments in the laboratory, but also for experiments on a semi-commercial scale and on a full commercial scale. The full-scale units include plants for cleaning, drying and pulverizing coal, for the manufacture of fuel gases, hydrogen, and coke, and there are full-size boilers of several kinds. Much experimental work has been undertaken not only at the Fuel Research Station, but also at industrial works in co-operation with industry.

In addition to the Fuel Research Station, there are nine Coal Survey Laboratories in various parts of England, Scotland, and Wales which have been undertaking, in collaboration with the Geological Survey of the Department, a comprehensive survey of the qualities of the national coal resources. This survey is now being put on a quantitative basis in co-operation with the Coal Commission and the Ministry of Fuel and Power. As a result of this survey, we already have much more information about our coal reserves and the coals on the market than there is about the coals in any other country. This information has been of immense value during the war, and further information is being rapidly collected. Without such information economic planning of the use of the coal reserves in the future would be impossible. Planning of this kind is becoming of great importance, because some of the coals with special properties, for example, coals of most value for making gas and coke, are limited tn quantity, and should not be used for purposes for which other more abundant coals are suitable.

Referring to some of the achievements of the Fuel Research organization, Dr. Parker said that many full-scale plants for the manufacture of smokeless fuel for the domestic fire had been investigated. One of the processes now in operation in industry was developed at the Fuel Research Station. In work on the domestic fire itself, a simple firegrate had been designed which produces when burning coal less than one half of the quantity of smoke emitted from grates of usual type. Simple equipment had also been developed for fitting to large industrial boilers, which not only greatly reduces the quantity of smoke from the boiler chimney, but increases the efficiency of the coal in raising steam. A large number of boilers in commercial use are now fitted with this equipment.

Work on transport producers using coal and coke in place of petrol for road vehicles was begun at the Fuel Research Station before the war. This work led to the introduction of the Government Emergency Producer now in use on many road vehicles, with a consequent saving in petrol.

Much is heard nowadays about processes for the production of petrol and other oils and chemicals from coal. Processes of this kind have received considerable attention at the Fuel Research Station, where a great deal of information has been obtained from experimental work on the distillation of coal, hydrogenation of coal and of tar, and on synthetic methods of producing oils and chemicals from gases made from coal and coke.

Continuing, Dr. Parker said that for many years coal is likely to continue to be used in much greater quantity as a direct or indirect source of heat, light, and power, than as a basis for the manufacture of valuable chemicals. At the same time, as scientific knowledge advances, there will be an increase in the number, variety, and extent of processes employing coal as a base material for oils and chemicals of many kinds.

There must also be a spirit of mutual help in research, involving friendly discussion and collaboration between the scientists in Universities, in Government establishments, industrial research associations, and other research organizations. In relation to fuel in this country, a good beginning in this direction has already been made. The Department has set up a consultative conference on fuel research, which is attended by representatives of the Iron and Steel Industrial Research Council, the British Refractories Research Association, the British Electrical and Allied Industries Research Association, the British Coal Utilization Research Association, the British Hard Coke Research Association, and the Gas Research Board.

The Manufacturer and the Gas Industry*

By H. R. HEMS,

Superintendent, Industrial Heating Section, City of Birmingham Gas Department, and Chairman, Industrial Gas Centres Committees

(*Continued from p. 27*)

The Birmingham Gas Committee and the Department's officials realized many years ago the value of the industrial load. They have endeavoured to keep that appreciation in tune with the changes which are continually taking place in industry. With the field of opportunity available in Birmingham and the surrounding district, with the multiplicity of trades and processes, probably more marked than anywhere else in the country, the development of industrial gas in that area could not have been left to its own resources. No doubt a considerable load would have accrued to the Department, but nothing like the figures which have been obtained would have been realized without the intensive activity which is continually carried on by service to consumers, the Department's readiness to adapt gas heating to older processes, and to undertake experimental work in connexion with any new process involving careful attention to the designs of furnace, and the application of gas by many forms of burners and industrial apparatus, this work being carried out whenever possible with the co-operation of the makers. An extensive service scheme of inspection of all furnaces in the area is operated, repairs to all forms of gas furnaces undertaken and special furnaces designed and installed when necessary. On this point may I say that this special work is not carried out in competition with makers, but it must be realized that many propositions are put before a gas undertaking which may mean a valuable gas load but may mean very little of a business nature to the furnace manufacturer, although they also readily undertake propositions which may be of an experimental nature.

The idea of experience such as that obtaining in Birmingham being available to undertakings in the near vicinity led to the Birmingham Gas Committee placing the service of its industrial experts at the disposal of those undertakings, and when similar conditions were occurring in other parts of the country, it was logical that a national organization should be set up which co-ordinated the work of these undertakings. This has been done in the form of Industrial Centres, of which ten are now operating, under the auspices of the Joint Co-ordinating Committee representing the National Bodies with the Industrial Gas Centres Committee carrying out the technical work. As Chairman of that Committee, it has been my privilege recently to welcome into the organization the Scottish Centre, to the establishment of which we have looked forward for some considerable time.

Each Industrial Centre operates in its area as a complete organization, but has representation on the Industrial Centres Committee. The type of work carried out by each Centre is naturally affected by the trades and processes within the area covered. Dispersal of manufacturing processes, which has taken place recently, serves an excellent example of the value of the pooling of the work of each Centre through the Industrial Centres Committee, which makes it possible for one Centre to obtain information on industrial gas applications to processes which may not previously have been carried out in that area, but which may be common practice in others. Individual Centres submit reports to their subscribing undertakings in addition to the quarterly reports which are issued under the aegis of the Centres Committee, and are intended for all subscribing undertakings. These reports have covered a very wide field of gas application and development, and have summarized such valuable work as space heating, bread baking, and bright annealing in pre-war days, and during the war the collective information on subnormal pressure working and emergency alternative fuel working, with many of the aspects of gas fuel utilization in connection with munitions production.

Recently, of course, part of the work of the Committee has been concentrated on the question of economy, and assistance has been given to the Ministry of Fuel and Power in this vital effort.

The individual Centres and the Committee co-ordinating their work will play a most important part in the manufacturing change-over from war to peace conditions; from the point of view of the future of the Gas Industry, an even more vital part than we have played under wartime conditions.

I express the hope that the importance of the industrial load and its development will place the Industrial Centres organization in the forefront of the work of any new body which may be set up by the Industry for post-war development, and I would like to see a conference of all industrial experts attached to undertakings with industrial potentialities immediately after the war, even if it is not justified before the war ends, to discuss propositions of mutual interest, and to obtain a lead as to the work which the Industrial Centres Organization can develop in the future.

* Paper to the Scottish Junior Gas Association (Eastern District).

Carbonization in Continuous Vertical Retorts

In the "JOURNAL" of December 22, p. 787, we gave a summarized report of the oral discussion on the Paper, "The Mechanism of Carbonization in Continuous Vertical Retorts," given by Dr. A. E. Haffner and Dr. F. R. Weston to the Eastern Section of the Southern Association of Gas Engineers and Managers. The Paper itself we published in full. Since then there have been written communications, and the Authors have replied to the whole. We now complete our story by the following outline:

Replying to the remarks of Col. F. J. Bywater, the **Authors** said it was true that the crucible swelling test did not differentiate readily between various kinds of Durham coals, since nearly all of them fell in the higher swelling classes numbered 7 to 9. In this respect the dilatometric method used by Audibert and in the Sheffield Laboratory Coking Tests gave precise indications. The value obtained in the crucible test was, however, very sensitive to oxidation or heat treatment of the coal, and it was for this reason that the method was selected. In future work they would include the Audibert test as well.

In regard to Dr. Lessing's comments, it was probable that in the top of the retort before a coke skin had formed gases did pass through the coal and effect valuable heat interchange, which did, however, little more than dry the coal. They agreed that carbon penetration was due to diffusion and pyrolysis of hydrocarbons within the brickwork, whereas scurf deposits contained in addition by-products of cracking of more primary distillation compounds.

In reply to Dr. King, they were satisfied that the iron tallies did not travel faster down the retort than the brick tallies. Maximum scurf deposit occurred at 10–14 ft. down the retort. The protective effect of the scurf caused retort wear to be least where the scurf was thickest, with the exception of the top of the retort. Release of ash due to steaming would appear to be a negligible effect, and wear seemed to be a matter of erosion only.

Bell-bottomed retorts were falling out of fashion because the space they occupied did not permit secondary air preheating flues to be incorporated as well. Straight retorts operated therefore with a substantially lower fuel consumption.

Mr. **H. J. Toogood,** in a written communication, remarked that at the outset of the intermittent retort (1908) the weight of the charge was believed to be supported by the bottom lid, but he was convinced this was incorrect. He was sure that the superimposed weight was largely taken by thrust against the retort wall. In certain cases it was subsequently observed that the bulk of the fully carbonized coke was suspended as a "pendulum" for a short period, hanging from the coke less carbonized forming the cap of the charge in the narrower upper regions of the retort—proving that the incandescent coke, as a monolith, possessed some tensile strength. In 1910–11, in pioneering continuous retorts, he continued the outward taper of the retort to the extractor, by which means less than 10% of the weight of the superimposed charge was taken by the mechanism.

The Authors had said that the first formed envelope of coke was fissured by the expansion strains of the contained coal. He submitted that it was fissured by this expansion and also by the thrust due to the superimposed weight of coal. He also considered that as long as the "pendulum" existed the continuous retort worked well, but that should the "pendulum" be broken a time lag would ensue before the retort worked as before.

The Paper set forth the causes of irregular travel of the charge, the prime cause being the condensates within the free space and the pitch refluxed from the gas offtake pipe, the second cause being inadequate rodding. He suggested a third cause. At the base of the angle of repose of the incoming coal the envelope of newly formed coke was, say, 2 in. deep, while at the opposite end of the major axis the coke envelope was deeper and stronger. On descent, the internal thrusts from the coal expanded this delicate envelope, the expansion fissure being on the gas offtake side. If the fissures were sufficiently severe to permit coal particles to enter the cracks, actual hold-ups were fostered. This reason prompted him to design the coal intake centrally.

The Authors, in reply, said they found it difficult to accept the "pendulum" conception of the charge. There would seem to be insufficient pressure against the walls and insufficient tensile strength in the coke for the charge to be literally "hanging." When a charge stuck, they considered it to be due to the fragmentation of the monolith and consequent jamming by arching. Mr. Toogood would add the thrust of the superimposed coal to the forces causing fissuring of the outer skin of coke, but such a thrust could not exceed 10 lb./sq. in., whereas the pressure of carbonization might be 700 lb./sq. in. They would substitute "monolith" for "pendulum," though they completely agreed that offtake pipes should not act as reflux condensers. The crude gas should be cooled by spraying as early as possible.

Mr. **J. R. Owen** (Slough) said it would be interesting to compare the results given in the Paper with similar tests on the straight-through type of retorts. With the bell-bottomed retorts the charge appeared to take 6½ hours to reach the top of the steaming chamber and almost 4 hours to pass through this chamber. Further, the monolith of coke on entering the bell appeared to split along the major axis into two half-monoliths which no longer filled the available space. Presumably in the straight-through retort this did not occur as the space available was very limited, due to the absence of the steaming chamber. In view of the fact that coal took approximately the same total time to pass down through the extractor in both designs, the rate of travel in the top 20 ft. of the retort must be slower in the straight-through type and faster in the remaining portion of the retort, as compared with the bell-bottomed type. Most of their carbonizing difficulties were caused by indifferent rodding.

The Authors said they would expect the throughput in a straight retort to be slightly less and rate of descent of the charge to be constant all the way down. The monolith would not be expected to split until close to the worm, and extraction was expected to be more critical than in the case of the bell-bottom.

Mr. **L. Muir Wilson** (South Metropolitan) remarked that from his experience the carbon which penetrated into the cracks and pores when a retort was worked under slight pressure had much more to do with keeping it tight than a layer of scurf. What were the mean differential pressures across the retort walls? Naturally carbon was not likely to remain in the brickwork if there was a tendency for waste gases to leak inwards. This might have some bearing on the fact that less penetration was noticed at the bottom than the top, for it was possible that the pressure inside the retort was higher, due to natural buoyancy, at the top than the bottom. Again, might not the bottom atmosphere of the combustion chambers be more oxidizing, and might not some of the grey discoloration be due to the presence of reduced compounds of iron?

The Authors replied that the pressure distribution in the heating flues increased steadily from −9/100 in. W.G. at the base to 5/100 in. W.G. at the top of the setting. The pressure distribution in the retort itself was obscure, and though level gauge was operated at the top of the retorts there might be definite pressures at the base. This was because the resistance to gas flow of a charge derived from Durham run-of-mine coal was a greater factor than the buoyancy of the gas. Consequently there was a tendency for coal gas leakage to occur at the base and for waste gas inleakage at the top. The atmosphere in the bottom combustion chambers was not more oxidizing than that at the circulators. The distribution of carbon penetration could be explained as follows: (1) It was not found below 20 ft. because of the lower concentration of hydrocarbons at this level. (2) It was not formed where there were heavy scurf deposits because of the tightness of the scurf skin. (3) It was formed notably in the top 5 ft. of the retort because of the relative thinness of the scurf deposit and the high concentration of hydrocarbons.

Mr. **E. E. Calvert** (Gas Light and Coke), referring to the structure of the charge in the steaming chamber, said the coke was not completely filling the available space. Contraction of coke always took place, and hence the efficiency of water gas production was low and erratic on account of uncertain contact of coke and walls. If it was recognized that the greatest temperature zone of the retort was approximately half-way down, might it not be worth while considering building the top portion, where the swelling of the coal took place, causing excessive wear and tear, in fireclay instead of silica?

The Authors replied that the coke in the steaming chamber did not fail to fill the available space because contraction had taken place. The space was mainly due to the splitting of the monolith into two halves, to a smaller extent due to fissuring, and to a still smaller extent due to thermal contraction. The wear was not a maximum in the top portion, and it should be remembered that swelling of the coal took place all the way down until the level at which the coal disappeared.

Mr. **R. P. Donnelly** asked what interpretation the Authors placed on the varying ash content of the coal and coke samples in regard to steaming. He suggested that in future work the Authors should charge some coal at intervals with which was mixed an oxide of characteristic colour.

The Authors replied that since the steaming reaction removed only 3% of the coke and therefore only increased the ash content from, say, 10% to 10.3%, the use of ash content to locate the water gas production zone was unreliable. There were sufficient differences in the individual lumps of coal to mask the difference due to steaming. The difficulties with powders as a means of distinguishing different times of carbonization were: (1) They tended to be diffused by blowing or settling, and their indications were not so precise. (2) The characteristic colour might be unrecognizable after carbonization. (3) The range of possible colours was limited compared with the ease with which numbers could be marked on tallies. (4) There might be criticism concerning the addition of catalysts to the coal.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

OXIDE PURIFICATION*

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THERE is no section of gas manufacturing practice more in need of a thorough investigation into the fundamentals of the chemical reactions involved than oxide purification. The very fact that hydrated oxides of iron, when present in sufficient quantities, react with hydrogen sulphide, so that the reaction is complete, a phenomenon which is rare in chemical industry, has caused gas engineers to be satisfied with the present cumbersome methods of purification.

The elimination of a gaseous constituent by means of a solid is an exercise in chemical engineering which requires careful thought, because of the difficulty of obtaining adequate contact, by reason of the heterogeneity of the reactants. Any serious approach to this problem has been avoided by the adoption of excessive purifying area or too frequent changing of purifying boxes. When one considers that in the largest purifying plants in this country the oxide requires eight foulings to reach a sulphur content of 40%, the need for improvement can be appreciated.

It has been the dream of gas chemists, from the beginning of the present century, to develop a method of liquid purification by which hydrogen sulphide could be removed by washing with a reactive chemical compound in solution. All successful processes of this nature depend upon a continuous cycle flow of solution, so arranged that absorption of hydrogen sulphide from the gas takes place in one vessel and revivification of the solution in another. In order to obtain a high absorption capacity and thereby secure a low solution pumping cost, together with equipment of reasonable size, it is desirable to use as strong a solution of the absorbing materials as possible, consistent with other factors. All liquid methods of purification, however, possess two distinct disadvantages. Firstly complete removal of hydrogen sulphide has never been obtained; and secondly, they require constant technical supervision. Side reactions may take place with constituents of the gas other than hydrogen sulphide causing rapid deterioration in activity and complete replacement of the solution.

Professor Bunte, who has made an extensive study of this subject, is of the opinion that the reactions involved in dry purification are so near to perfection in their completeness that all efforts should be devoted to the intimate study and improvement of this method.

Little is known of the actual chemical and physical mechanism of dry purification, but what is would encourage one to believe that considerable improvement could be made in increased activity, decrease of ground space and reduction in back-pressure. These improvements should be accompanied with improved sulphur recovery.

With these ultimate objectives in view this fundamental work, extending over a period of two years, was carried out.

Theoretical Considerations

While it has been recognized that the ferric hydrate content of natural iron oxide is the most important factor in the removal of hydrogen sulphide from coal gas, much exact information is missing from most discussions on this essential phase of the Gas Industry in Australia. Until recently it was assumed that the ferric oxide content roughly indicated the reactivity of an oxide. Then it was realized that the water of hydration exerted a definite influence, and so it has been the practice of the Gas Industry to use, for hydrogen sulphide removal, Port Macquarie oxide containing 6% or more of water of hydration and a total iron content calculated as ferric oxide of over 70%. Impurities include silica and aluminium, together with chromium, probably as the oxides. The water of hydration is taken as the loss when oxide previously dried at 105°C. is heated above 750°C. As a check, the water vapour evolved by heating was absorbed by calcium chloride. The results agreed exactly with the loss of ignition.

Doubt has hitherto been expressed with regard to the proportion of water linked with ferric oxide. At temperatures below 100°C. many so-called hydrates have been observed. Bohm considers that certain gelatinous substances may contain water in solid solution between the oriented molecules of the space lattice, whilst Posnjak and Merwin, continuing further, established the fact that water molecules may assume a fixed position in the ferric oxide lattice to form the monohydrate $Fe_2O_3.H_2O$. This monohydrate is stable at 100°C. and its presence in Port Macquarie oxide has been established. Wedekind and Albracht found that the magnetic susceptibility of anhydrous ferric oxide is four or five times less than the hydrated ferric oxide and so conclude that a compound is formed. Port Macquarie oxide has a high magnetic susceptibility. When heated to about 400°C. losing portion of its water of hydration, the magnetic effect was considerably less, while oxide heated to 700°C. and so entirely free of water of hydration was only slightly magnetic.

Assuming the presence of the monohydrate, let us consider its reaction with hydrogen sulphide. Possible reactions are:

(i) $Fe_2O_3.H_2O + 3H_2S <-> Fe_2S_3 + 4H_2O$.
(ii) $Fe_2O_3.H_2O + 3H_2S <-> 2FeS + S + 4H_2O$.

Pearson, Robinson, and Sayce found that the second reaction did not occur to any appreciable extent below 100°C. Bruckner investigated the first reaction and asserts that the reversible reaction with the reformation of the hydrate is negligible below 40°C. As the mean temperature at which the purifiers operate does not exceed this figure, we may more fully consider the reaction $Fe_2O_3.H_2O + 3H_2S \rightarrow Fe_2S_3 + 4H_2O$.

A sample of Port Macquarie oxide exhausted under favourable conditions with hydrogen sulphide absorbed 30.5% based on the weight of the dry oxide. With the molecular weight of $Fe_2O_3.H_2O = 178$, and hydrogen sulphide 34, then according to the above reaction the percentage of hydrate would be 53.2% by weight of the dry spent oxide. Actually this oxide, with a water of hydration content of 6%, contained 59.3% ferric hydrate, so that the agreement is fairly close. The exhausted oxide on revivification and subsequent fouling gave a figure closer still, due to the first revivification breaking up the oxide into a more suitable physical condition for hydrogen sulphide absorption. Thus we may assume the reaction—

$$Fe_2O_3.H_2O + 3H_2S \xrightarrow[\text{below } 40^\circ\text{C.}]{} Fe_2S_3 + 4H_2O + 14.9 \text{ cals.}$$

to be the important one in hydrogen sulphide absorption by Port Macquarie oxide.

The revivification process—that of subjecting fouled oxide to a current of air or oxygen in the presence of free water—may now be considered. The reaction may be expressed as—

$$2Fe_2S_3 + 3O_2 + 2H_2O \longrightarrow 2Fe_2O_3.H_2O + 6S + 145 \text{ cals.}$$

The reaction is strongly exothermic, and care must be taken to keep the temperature below 50°C. otherwise the oxidation to sulphates is appreciable. The reaction results in the formation of the hydrate, not the oxide, and the initial water is essential. Milbourne and Huff in their experiments on the relative effects of humidity variation on the revivification reaction demonstrate this most effectively as shown in graph No. 1. The fact that moisture is essential for revivification is obvious. The revivified Port Macquarie oxide has a magnetic susceptiblity similar to the fresh material, suggesting the formation of the hydrate, as the hydrate possesses a magnetic susceptibility approximately four times that of the normal ferric oxide. The reactivity of the revivified oxide is similar to the original, the second fouling being slightly better than the first, probably due to the physical breaking up of the oxide into a freer mass.

Essential work on oxide reactivities has been carried out by Bruckner. He not only assumes a monohydrate, but has apparently prepared four different forms of the ferric monohydrate, each one having a different activity with regard to hydrogen sulphide absorption. He considers that there are three definite crystalline forms, α, β, and γ, together with the amorphous form. The dimensions of the particles are in the vicinity of 10^{-5} cm., and the hydrates are coloured as follows:

α—bright yellowish brown. β—red brown.
γ—brick red. amorphous—brown.

The reactivity of each form in the presence of varying percentages of free water may be seen in graphs 2, 3, 4, and 5.

Except that the most suitable reaction temperatures lie between 30°C. and 40°C., no data are available concerning the temperature at which the reactivities are determined, so comparisons can be only approximate. The first important piece of information is the fact that the crystalline forms have a greater rate of absorption than the amorphous form, but not necessarily a greater total absorption. The α form reacts more rapidly with an increase in free water content, but the total absorption is the same.

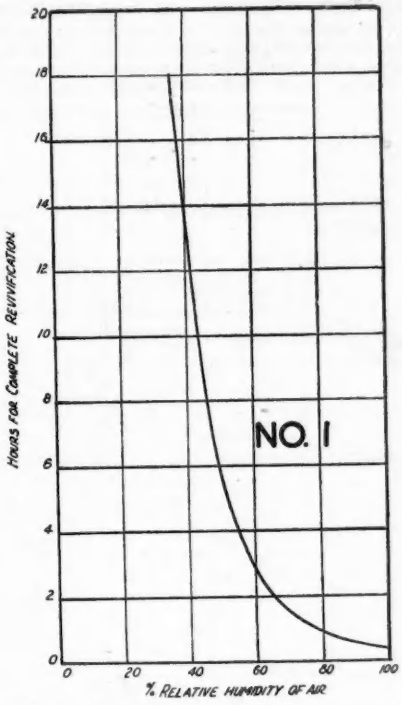
The β form appears to be unaffected by free moisture, while the γ form is greatly dependent on moisture both for reactivity and total absorption. The amorphous type is considerably affected by free moisture with regard to reactivity, and slightly so in the case of total absorption.

Experimental Method

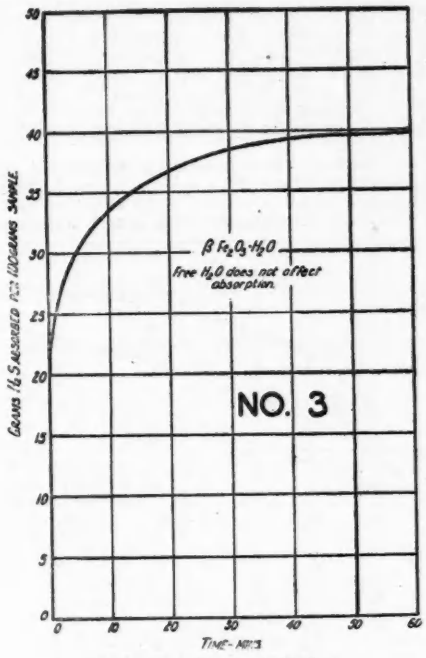
The method used by Bruckner in obtaining measurement of reactivity and a modification of the one used by the Australian Gas Light Company were both employed in our work on Port Macquarie oxide and gave strikingly comparative results. The equipment is briefly described as follows:

1. Bruckner Method: The apparatus consisted of a stout-bottomed

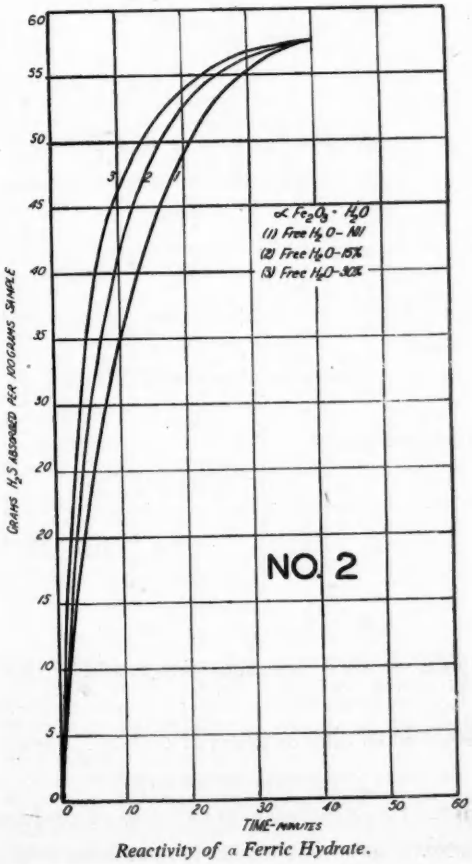
* Technical Research Report No. 2 of the National Gas Association of Australia.



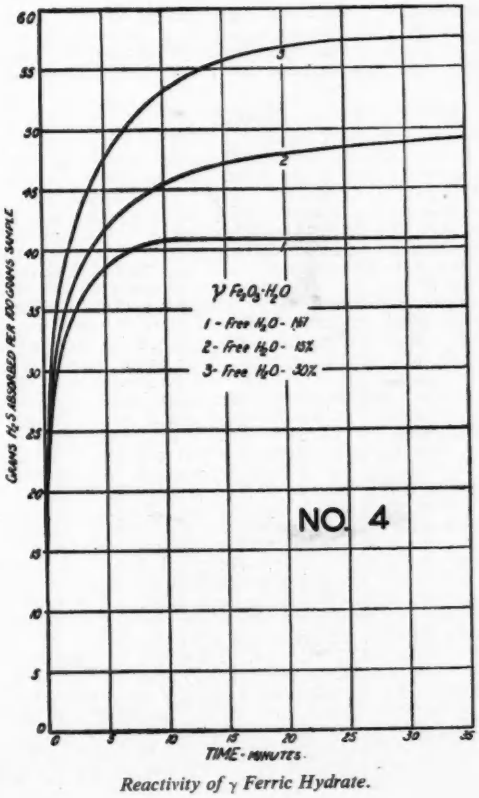
Effect of Relative Humidity on Revivification (Milbourne and Huff).



Reactivity of β Ferric Hydrate.



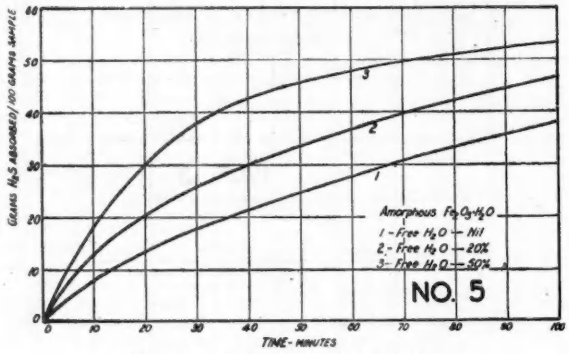
Reactivity of α Ferric Hydrate.



Reactivity of γ Ferric Hydrate.

flask of 1,140 mls. capacity, with well-fitting rubber stopper drilled to take an inlet tube, an outlet tube, and a mercury manometer capable of registering up to 18 in. mercury vacuum. The flask was immersed in a water bath, the water being kept in circulation by mechanical agitation, and the temperature controlled by means of a small gas flame inserted in a submerged tube. In each test, hydrogen sulphide was passed through the flask until all the air had been dispelled; 2 gm. of the oxide under test was then introduced into the flask and hydrogen sulphide passed for half a minute. The flask was then sealed and the pressure drop over definite intervals noted. The volume and subsequently the weight of hydrogen sulphide absorbed was then calculated.

2. Mortlake Method: The apparatus (fig. 16) consisted of a U tube, the inlet side containing 2 gm. of the oxide to be tested, the outlet side containing granular calcium chloride. Plugs of cotton-wool kept the oxide and chloride in position. Attached to each end of the U tube



Reactivity of Amorphous Ferric Hydrate.

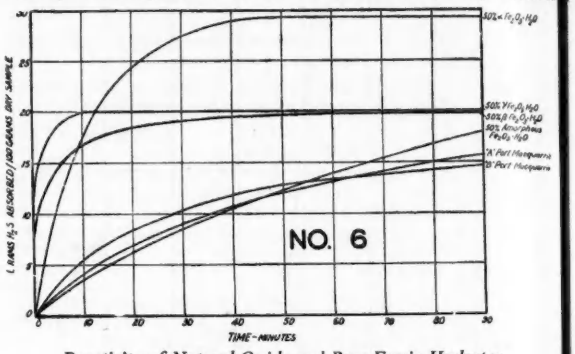
by tight fitting rubber tubing was a glass tap. The U tube, filled and with taps closed, was thoroughly dried and weighed. Then it was immersed in a water-bath so that the oxide was at least one inch below the surface of the water. Pure hydrogen sulphide generated in a Kipp's apparatus was dried by passing through a calcium chloride tower, then through the U tube, where a portion was absorbed by the oxide; the remainder dried by the calcium chloride was burnt at a micro-burner. The rate was adjusted so that there was just a slight excess of hydrogen sulphide burning at the outlet. At definite intervals the passage of hydrogen sulphide was stopped, the taps of the U tube closed, the tube wiped thoroughly dry and weighed. The tube was then reconnected to the circuit and hydrogen sulphide passed for a further period. The increase in weight of the U tube gave a direct figure for the weight of hydrogen sulphide absorbed, and so the reactivity of the oxide was calculated.

Results

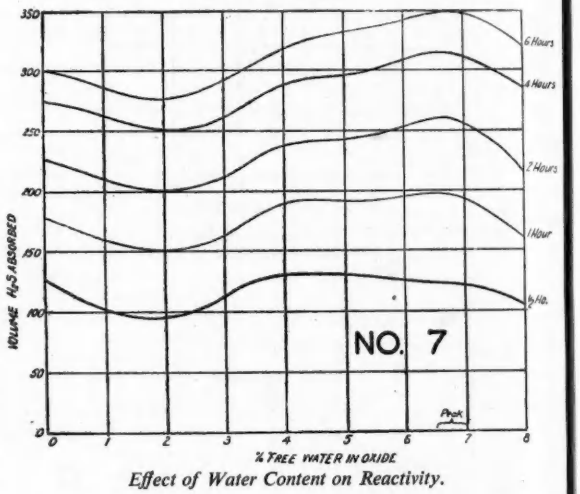
The reactivity of Port Macquarie oxide has been determined, and while different samples show small fluctuations, the general nature of the graphs plotted is the same. We have seen that the active hydrate content is slightly over 50% of the total amount of oxide, and so comparisons have been made with graphs representing 50% of the various forms of hydrate. Graph No. 6 shows typical Port Macquarie oxide reactivities compared with the standard forms. The temperature of reaction of the Port Macquarie oxide was fixed at 30°C. (80°F.), no initial free moisture being present. Obviously the amorphous form is predominant, but there is a tendency for a slightly higher initial absorption which suggests a small percentage of crystalline hydrate. Certainly temperature and free water content bring about a variation in activity, and different samples show appreciable changes, but generally this initial increased reactivity persists. The second variation from the amorphous form is the slackening-off of absorption of the Port Macquarie oxide. Although not shown in the graph, the total absorption is in excess of the 50% amorphous form, yet after about an hour there is the "depression" in the curve. The explanation is that the impurities in the oxide begin to exert a definite influence. The increase of free water up to 50% of the oxide beneficially affects the reactivity of the amorphous hydrate in its pure state, but Port Macquarie oxide has an optimum of 7%, suggesting that the impurities in the presence of excess water either chemically or physically retard hydrogen sulphide absorption. The physical consideration is the more probable. A clogging of the pores, or a coating of film over the active hydrate, seems a reasonable explanation. It is possible that the depressant effect is actually experienced right from the start of reaction; that being the case, the proportion of crystalline hydrate would be greater than appears at first sight. The α form is suggested, because as the increase in reactivity occurs mostly after the first five minutes, this would tend to discount the presence of the β and γ forms. A glance at the reactivities of these hydrates in graphs 2, 3, and 4 will clarify the position. The effect of temperature and free water content on the activity of the oxide is shown relatively in graphs 7 and 8. The most advantageous conditions are 6.5–7% free water and a temperature of 29½°C. to 32°C. (85° to 90°F.).

Effect of Hydrogen Ion Concentration

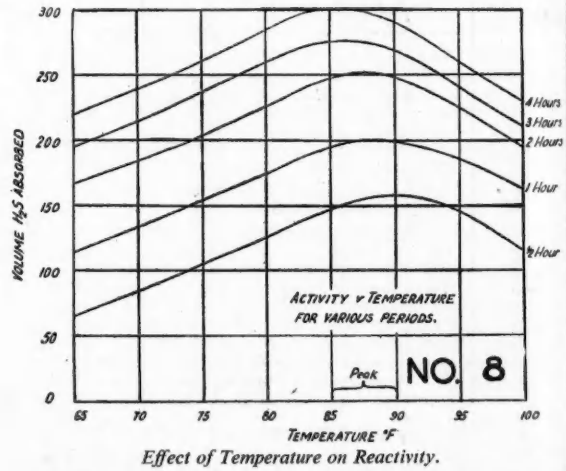
The effect of sodium carbonate addition on the reactivity of an oxide has been dealt with by Bruckner. In the case of bog ore containing a large percentage of the amorphous hydrate, and giving a reactivity curve very similar to Port Macquarie oxide, the presence of



Reactivity of Natural Oxide and Pure Ferric Hydrates.



Effect of Water Content on Reactivity.



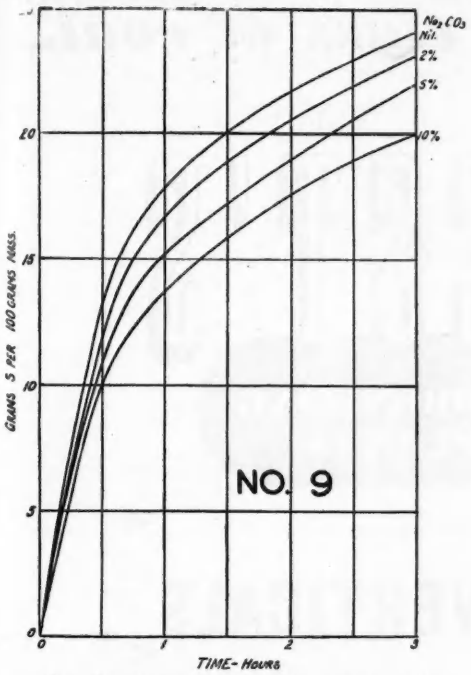
Effect of Temperature on Reactivity.

sodium carbonate was detrimental to hydrogen sulphide absorption. The results are recorded in graph No. 9.

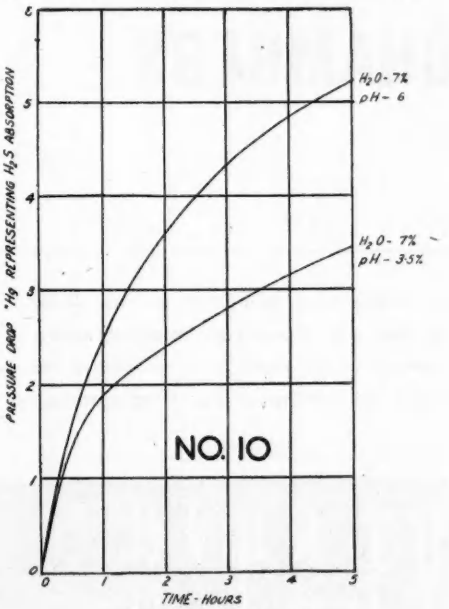
The absence of an acid condition during hydrogen sulphide absorption is desirable. The two relative reactivities shown in graph No. 10 were determined on oxide containing 20% sulphur. The revivified oxide had a pH value of 3.5. The second sample was obtained by washing the above oxide free of acidic salts, with the result that its pH value rose to 6. The free moisture content in both cases was fixed at 7%. The reduced activity in the case of the acidic sample is very evident.

Graph No. 11 shows the reactivities of oxide before revivification

for 24 hours with air and also after each successive revivification. Note that the second and third foulings are slightly higher than the first, due as previously suggested to the opening up of the oxide on revivification. The fifth fouling indicates high temperature revivification with the formation of sulphates resulting in an acidic oxide with, as previously shown, a correspondingly low reactivity. Admittedly, the



Effect of Sodium Carbonate addition on Reactivity.

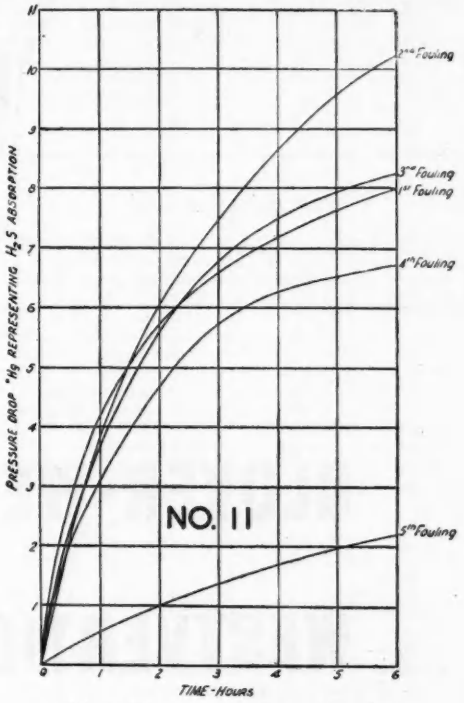


Effect of pH on Reactivity.

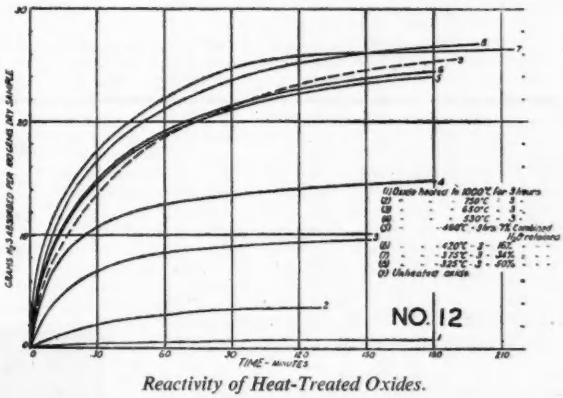
presence of increasing quantities of free sulphur prevents perfect absorption and oxidation as shown by the lower fourth fouling values, but the large drop of the fifth fouling is partly due to acidity. The hydrogen sulphide absorption values are only relative, being recorded as a pressure drop. The type of curve is the same in each case, so that the nature of the amorphous hydrate has not altered while undergoing these intermediate reactions.

Effects of Roasting

When a hydrated ferric oxide is heated to 1000°C. it loses its water of hydration and its reactivity on cooling is practically *nil*. There has been a tendency to couple these two facts and assume that the presence of the hydrate is essential for hydrogen sulphide absorption. In order to investigate this reaction, a sample of Port Macquarie oxide was dried at 105°C. for three hours and then cooled in the absence of water vapour. A weighed quantity of this oxide was heated for three hours at a temperature of 1000°C., cooled in the absence of water vapour, and reweighed. As previously established, the percentage loss on ignition represented the percentage water of hydration. Similar weighed quantities were subjected to three hours' heating in an electric furnace, the temperature being varied with each sample. The loss of weight in each case was obtained. The percentage water of hydration retained in the oxide, after subjecting to a certain temperature for three hours, was calculated by comparison with the total



Effect of Successive Foulings on Reactivity.



Reactivity of Heat-Treated Oxides.

water of hydration originally present. It was found that above 500°C. there was no appreciable water of hydration present in the oxide. In order to prove that no stable hydrate was reformed by the simple addition of water to the ferric oxide, a sample previously heated to 460°C. and so losing 93% of its water of hydration was dried at 105°C., weighed, and 10% of water added. After two hours the oxide was dried at 105°C. and reweighed. There was no appreciable difference in weight, indicating that no hydrate stable above 105°C. had reformed.

The various samples of oxide which had been subjected to heat treatment were then tested for hydrogen sulphide absorption, and the reactivities are shown in comparison in graph No. 12. Up to a temperature of about 460°C., during which period 93% of the water of hydration was lost, the oxide retained practically a normal reactivity. The initial absorption was slightly in excess of the unheated oxide, while the total absorption was slightly lower. From about 500°C. to 700°C. the reactivity is considerably lower, at 750°C. still less, and at 1000°C. practically *nil*.

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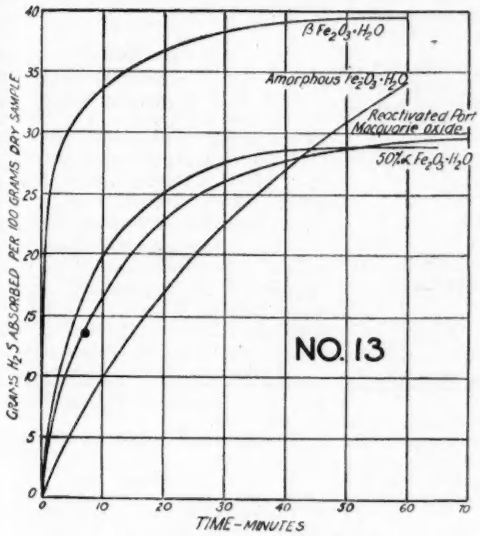
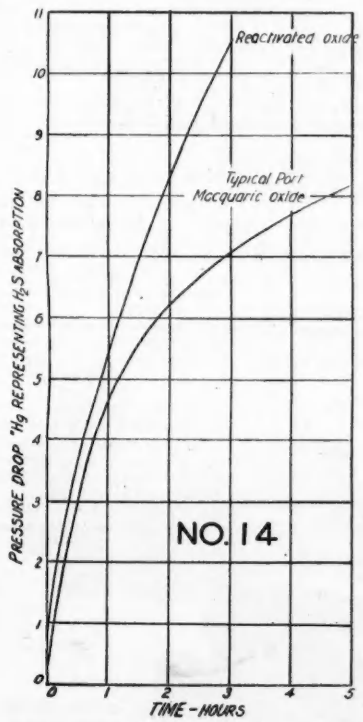
Cubic and Rhombohedral Forms of Ferric Oxide

It is evident then that the absorption of hydrogen sulphide is due firstly to ferric oxide—in a suitable form. If present as the hydrate, the oxide is suitable, but the water of hydration only ensures its physical condition and is itself not essential chemically. Let us then consider the data concerning anhydrous ferric oxide. It has been established by a number of workers in this particular field that ferric oxide can and does exist in at least two crystalline forms, probably more. Apparently there is a cubic and a rhombohedral form, the former quite reactive and comparatively unstable, the latter less reactive and



Reactivity of Activated Natural Iron Oxide.



Reactivity of Activated Natural Iron Oxide.

more stable. There is an irreversible transition of the cubic to the rhombohedral form within a temperature range of approximately 500°C. to 700°C. The mode of preparation of the oxide and the presence of aluminium and chromium oxides affect the transition temperature, so the figure is very approximate. A glance at the graph shows a definite drop in reactivity between 460°C. and 530°C., so possibly some such change has begun. A second transition has been suggested by several observers. Bidwell noted breaks in the electrical conductivity and thermoelectric curves at about 720°C., and Sogman a drop in the magnetic susceptibility at 675°C. The reactivity at 750°C. is much less than at 650°C., so that the graphs do not in any way contradict these possible changes, but the most probable solution is that a gradual change occurs between 500°C. and 700°C. with a steady drop in reactivity as the stable less reactive form is produced, and that the 750°C. values represent the rhombohedral almost entirely. It must be remembered of course that only 50% of the natural oxide is in the true reactive form, so the values must be doubled to obtain a true indication of the pure rhombohedral ferric oxide reactivity. At 920°C., according to Kohlmeyer, finely divided ferric oxide tends to sinter and increase in density. This would account for the oxide heated to 1000°C. being pratically inert. Examining the reactivities of the various hydrates of ferric oxide, it would appear that the hydrates are slight variations of the cubic reactive, unstable ferric oxide, while the inert ferric oxide present in Port Macquarie oxide is probably the stable rhombohedral form sintered to render it practically unreactive to hydrogen sulphide.

(To be continued)

Coke Extraction

Among recent patents is one (No. 555,024) taken out by the Standard Furnace & Setting Company, Ltd., A. W. H. Priestley, and A. W. Dixon. It relates to coke extraction from vertical retorts or chambers. The retort or chamber is so adapted as to be available for continuous, semi-intermittent, or intermittent operation. The retort is provided at the base with an operating platform, ram, series of fingers, or like means, upon which the charge is supported. The platform, ram, or the like is adapted to be reciprocated, the coke at the base of the retort being pushed by the ram movement from an inner casing towards and over a receiving plate, the inner portion of which is fixed and the outer part pivoted, over which the coke is discharged through an outer casing into a coke box and delivered by way of a door therein. Means are provided for varying the stroke of the platform or ram, and for withdrawing it clear of the inner casing, into a housing. Above the pivotal part of the receiving plate is a pivoted lintel. The latter and the pivoted receiving plate are operated from the exterior of the retort so that their angularity may be adjusted, the lintel and pivotal portion of the receiving plate controlling the effective angle of repose of the coke.

In one embodiment of the invention, the charge is supported at the base of the vertical retort upon an operating platform or ram which bridges across a space between a frame within which it may be housed on one side of the retort base and a receiving plate on the other. The platform or ram is mounted for reciprocation and in operation moves at each stroke a short distance on to the fixed receiving plate. Beyond this and forming an extension of the fixed portion is a pivoted outer part, the angularity of this latter being variable from a vertical position extending above the pivot to a dependent position. The adjustment of this pivoted part of the receiving plate is effected from a lever handle on its spindle outside the main casing of the retort. Above this pivotal part of the plate is a pivotal lintel, the dependent angularity of which may also be adjusted from the exterior and the function of which is to regulate the opening at the base of the retort from the inner to the outer casing, so that the extent of the angle of repose of the coke may be controlled. A housing frame for the platform or ram is disposed at one side of the retort, between which housing and the first portion of the receiving plate the ram is reciprocated to an extent which is adjustable, or the ram may be entirely withdrawn into or from the housing for inspection. Guides are fitted in the upper portion of the housing engaged by rollers mounted upon a member operating the ram, and rollers running on tracks are mounted below the platform or ram, so that the reciprocation of the latter is facilitated.

In operation, for a continuous action the pivotal part of the receiving plate is set horizontally and the ram is reciprocated on its rollers from a rod operated by, say, an eccentric or crank, the coke being pushed over the pivotal part of the receiving plate and dropping freely into the coke box below.

To empty the charge from the retort, or to work intermittently or semi-intermittently, the operating platform or ram is moved completely back into its housing frame away from the receiving plate, leaving a clear discharge space between the housing and the receiving plate through which part of the charge may fall into the coke box below. Before the coke is discharged, the operating platform or ram is returned to the forward position on the receiving plate ready for further action, except when it is necessary to empty the retort quickly, the coke being then emptied from the box below.

In order to charge the retort when empty, the pivotal part of the receiving plate is moved to an upwardly inclined or vertical position, closing the space where the coke lies at an angle of repose and thus effectively preventing any overflow from the retort to the coke box while the retort is being charged, as with an initial filling or pad of breeze.

The operating mechanism as described may be so arranged that the path of the reciprocating ram is either horizontal or slightly inclined to the horizontal, say, at an angle of 20°, so as to give a slight downward motion to the platform or ram on its forward stroke.